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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

I.L.C. HATTEN-HECKMAN

DEN HAAG, DEN
THE HAGUE, 28/08/01
LA HAYE, LE

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Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

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Cathode ray tube with modified in-line electron gun

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Cathode ray tube with modified in-line electron gun

BACKGROUND OF THE INVENTION

The invention relates to a cathode ray tube having a longitudinal axis, a phosphor screen, an electron gun arranged around the longitudinal axis, the electron gun comprising a triode part having three cathodes for the generating of a red, a green and a blue electron beam, respectively and two common grids, arranged transverse to the longitudinal axis, and a focus lens part having at least two common grids arranged transverse to the longitudinal axis.

Normally, a cathode ray tube for television or other purposes is one having an envelope with a large bulb portion and a tubular neck portion fixed thereto. Mounted within the tubular neck portion are a plurality of electrodes for forming and focusing electron beams along a path extending into the bulb portion. Magnetic or electrostatic field producing means are used for moving the electron beams in any desired manner over a wall portion or face plate of the envelope bulb portion. The inner surface of the wall or face plate is coated with a film of phosphor material which luminesces with a visible light when struck by the electron beams. By modulating the current of the electron beams the scanned area of the phosphor screen can be varied in a manner to produce a light path in accordance with modulating signals applied to the electron gun of the tube.

When using a CRT during the manufacture of, e.g. a television set or a monitor, the setmaker has to set the white point. It turns out however, that the white point of the finalized apparatus sometimes is shifted and displayed images become discoloured.

SUMMARY OF THE INVENTION

Accordingly, a purpose of the present invention is to praide a cathode ray tube which enables a display having a substantially stable white point during its life.

The cathode ray tube in accordance with the invention is characterized in that the cathode for generating the green electron beam is offset from the longitudinal axis, the electron gun being capable of having the green electron beam in the centre of the phosphor screen.

The invention is based on the insight that initially, during the adjustments of the cathode ray tube apparatus, the "green" cathode has a *temporary* loss of emission due to rest gasses being present inside the tube and due to ionisation of the gas atoms leading to bombardment of the cathode surfaces. The emission improves substantially after one or two hours of tube operation (scanning ageing or raster ageing, also called the soak test). As a result, the white point is shifted and displayed images become more green.

The reason why the "green" cathode suffers more severely from loss of emission than the "red" and "blue" cathodes can be explained by the presence of kinks in the "red" and "blue" electron beams in the neighbourhood of grid G3a, necessary for convergence of the three beams. For reasons of symmetry (concerning electron guns with in-line cathodes), such a kink is not present in the "green" electron beam.

The unequal amounts of emission loss for the "red" and "blue" cathodes on one hand and the "green" cathode on the other hand lead to discolouration of the displayed images. Therefore, the goal of this invention is to obtain a new electron gun design for which the three cathodes are equally exposed to ion bombardment and, thus, suffer from emission loss with equal severity. This can be achieved by introducing a kink in the "green" electron beam too.

This kink can be constructed analogously to the kinks in the "red" and "blue" electron beams in either the horizontal direction or the vertical direction. This idea is worked out below for the cathode positions and for the positions of the grid apertures, where a slight offset from the longitudinal axis (z-axis), or from the original in-line plane (the x-z plane) is considered. A delta orientation of the three cathodes can also be considered.

The kink in the "green" beam requires a electron-gun design in which for the green beam apertures are made in the G2 and/or in the G3a-grid, which are eccentric with respect to the apertures in the G1 grid.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF DRAWING

In the drawings

Fig. 1 is a diagrammatic cross-section of an embodiment of a cathode ray tube for a picture display device;

Fig. 2 shows the positions of the cathodes (and grid apertures) in: (a) a current in-line configuration, (b) the "green" cathode shifted in horizontal direction, the "green" cathode shifted (c) in vertical direction;

Fig. 3 shows the positions of the cathodes (and grid apertures) in: (a) a current in-line configuration, (b) the three cathodes shifted in vertical direction by equal amounts, (c) the green cathode shifted more in vertical direction than the red and blue cathodes;

Figs. 4, 5 and 6 show schematic views of electron guns with three electron beams in which the green beam is kinked in three different manners.

The figures are purely diagrammatic and not to scale. For the sake of clarity, some dimensions are exaggerated. Corresponding components in the Figures have been given identical reference numerals as much as possible.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The cathode ray tube shown in Fig. 1 is a color cathode ray tube 1 having an evacuated envelope 2 comprising a display window 3, a cone 4 and a neck 5. The neck 5 accommodates an electron gun 6 for generating three electron beams 7, 8 and 9 extending, in this embodiment, in one plane. A display screen 10 is situated on the inner side of the display window 3. The display screen 10 comprises a plurality of red, green and blue-luminescing phosphor elements. Each group of (red, green or blue) phosphor elements forms a pattern. The display screen may alternatively comprise other patterns such as a black matrix (a black pattern) or color filter patterns. On their way to the display screen 10, the electron beams 7, 8 and 9 are deflected across the display screen 10 by means of a deflection unit 11. The arrow Z represents the direction of the longitudinal axis of the tube 1, and the arrow X represents the direction of the longitudinal axis of the display screen 10. Conventional electron guns of the in-line type have three cathodes which lie in one plane and generate three electron beams lying in that plane (generally the X-Z plane). The cathodes in that case have a configuration according to fig. 2a, the green cathode being aligned with the Z-axis.

During operation of the tube, gas atoms present inside the tube can be ionized by high velocity electrons. Positive ions, like argon ions, travel in the reverse direction of the electrons generated by the cathodes under the action of the electric field.

Bombardment of the cathode surface with positive ions can lead to (temporary of permanent) loss of emission if the area of bombardment and the emitting area coïncide. If

the loss of emission is not equal for the three cathodes, the problem of white point shift occurs.

The "kinks" present in the trajectories of the red and the blue electron beems (needed for convergence) have as additional effect that in tubes with a conventional in-line grow, where the trajectory of the green electron beam does not have a "kink", the emitting area of the red and blue cathode are less exposed to ion bombardment than the emitting area of the green cathode, and consequently suffer less of loss of emission.

Introducing a kink in the "green" electron beam will solve the above problem. This kink can be constructed analogously to the kinks in the "red" and "blue" electron beams by a translation of the "green" apertures in the triode grids in either the horizontal or the vertical direction. This is shown in Figure 2 for the positions of the cathodes and the grid apertures. A delta orientation of the three cathodes can also be considered. Also, a translation of the three cathodes in vertical direction can be considered, as shown in Figure 3. In figs. 2 and 3 the dotted line represents the original in-line plane (X-Z plane), and figs. 2a and 3a represent the conventional "3-in-line" cathode configuration in which the central (green) beam goes straight to the phosphor screen, without a kink in its trajectory. With the other configurations a kink is involved. The applicability and effectiveness of these kinks plus the magnitude of the translation of the green beam depend on the specific tube and electron gun.

According to configuration 2b the central (green) cathode is slightly offset in vertical direction from the original in-line plane. In tubes with smaller neck diameters configuration 1 (b) cannot give the desired effect completely, because there is insufficient space to shift the "green" cathode, and because the convergence of the electron beams is disturbed.

In this respect, a delta configuration (not shown) is even less attractive. Configuration 2c, in which the central (green) cathode is slightly offset from the longitudinal axis in the vertical direction has a better applicability.

The configuration shown in figs. 3b and 3c appear the more interesting ones.

In fig. 3b the plane of the three cathodes is offset from the original in-line plane. In fig. 3c the plane of the three cathodes is offset from the original in-line plane, and the central (green) cathode has got an additional offset in the vertical direction.

The configurations shown in figs. 2b, 2c, 3b and 3c involve a kink in the trajectory of the green beam.

Fig. 4 schematically shows an electron gun in which the trajectory of the electron beam 41 generated by the green cathode G gets a kink in grid G3a for convergence with the red and the blue beams in the centre of the screen.

However, when the kink is created in the G3a section of the electron gun, as is the case for "red" and "blue", the "green" electron beam will pass asymmetrically through the main lens. This may cause convergence problems because the deflection unit has been designed for in-line electron guns and is usually self-converging.

So, further modification of the current concept of an in-line electron gun / deflection unit concept may be necessary.

An alternative is shown in Fig. 5, where the trajectory of the green beam 42 has two kinks, one near grid 3A in the pre-focus section, and one before entering the area of the main lens 20, 21 e.g. in the DAF or DAF-DBF section, such that the green beam passes straight through the centre of the main lens 20, 21. This may overcome convergence problems.

The kink near grid G3a in the prefocus section is not much susceptible to the variation of the dynamic focusing potential, because the potential difference between grids G2 and G3a is in the order of several kV. Creating a kink in the DAF or DBF sections is more difficult, because the potential differences over these gaps vary between –300 and 1000 V. Of course, this only applies to DAF and DAF-DBF guns and not to non-DAF electron guns.

Another alternative, shown in fig. 6 is creating a first kink in the triode section between grids G1 and G2, and a second kink near grid G3a. Also in this case the green beam passes straight through the centre of the main lens 20, 21.

It is noted that in the art the term DAF is used to indicate a dynamic astigmatism focus lens and the term DBF to indicate a dynamic beam focus lens.

It is further noted that in e.g. conventional electron guns of the three-in-line type the pitch of the outer grid apertures (the apertures for the red and the blue beam) in the triode part is 6.020 mm and the pitch of the outer apertures in grid G3a is 5.080 mm. By this "eccentricity" the desired "kink" in the trajectories of the red and the blue beam is achieved. In analogous manner a kink can be achieved in the trajectory of the central (green) beam.

Summarizing: the invention relates to a cathode ray tube having an electron gun which is modified with respect to the electron gun having three equidistant cathodes lying "in line". The cathode for generating the green (central) beam is off-set with respect to its position in an in-line gun and the grids in the focus and/or triode part of the gun have been

modified to provide at least one kink in the trajectory of the green beam to restore convergence.

As cathodes of the impregnated type, so-called I-cathodes, are in particular sensitive to ion bombardment, the invention is especially suited to be implemented in CRT's which are equipped with I-cathodes.

CLAIMS:

1. Cathode ray tube having a longitudinal axis, a phosphor screen, an electron gun arranged around the longitudinal axis, the electron gun comprising a triode part having three cathodes for the generating of a red, a green and a blue electron beam, respectively and two common grids, arranged transverse to the longitudinal axis, and a focus lens part having at least two common grids arranged transverse to the longitudinal axis,

characterized in that the cathode for generating the green electron beam is offset from the longitudinal axis, the electron gun being capable of having the green electron beam in the centre of the phosphor screen.

2. Cathode ray tube according to Claim 1, characterized in that the green cathode lies in one plane with the red and the blue cathode, said plane including the longitudinal axis.

3. Cathode ray tube according to Claim 1, characterized in that the green cathode lies in one plane with the red and the blue cathode, said plane being parallel to, and spaced from, the longitudinal axis.

4. Cathode ray tube according to Claim 1, characterized in that the red and the blue cathode lie in one plane, in that the green cathode is spaced from said plane.

5. Cathode ray tube according to Claim 4, characterized in that the said plane is parallel to, and spaced from, the longitudinal axis.

6. Cathode ray tube as claimed in Claim 1, characterized in that at least one grid of at least one of the triode and focus lens parts of the electron gun is capable of providing a kink in the trajectory of the green beam.

7. Cathode ray tube as claimed in Claim 6, characterized in that a first kink is produced in the grid G3a area.

8. Cathode ray tube as claimed in Claim 6, characterized in that a second kink is produced in the DAF-DBF area.

9. A cathode ray tube as claimed in Claim 6, characterized in that a first kink is produced near grid G2 and a second kink near grid G3a.

ABSTRACT:

Cathode ray tube having an electron gun which is modified with respect to the electron gun having three equidistant cathodes lying "in line". The cathode for generating the green (central) beam is off-set with respect to its position in an in-line gun and the grids in the focus and/or triode part of the gun have been modified to provide at least one kink in the trajectory of the green beam to restore convergence.

Fig. 4

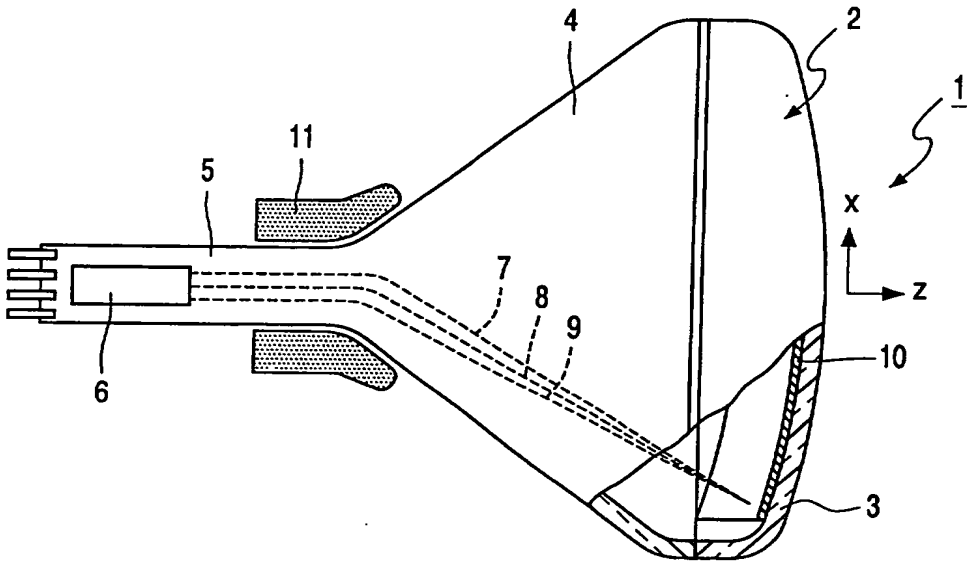

FIG. 1

2/3

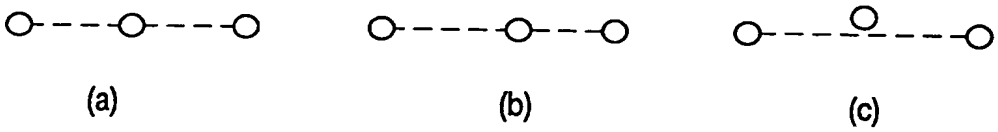

FIG. 2

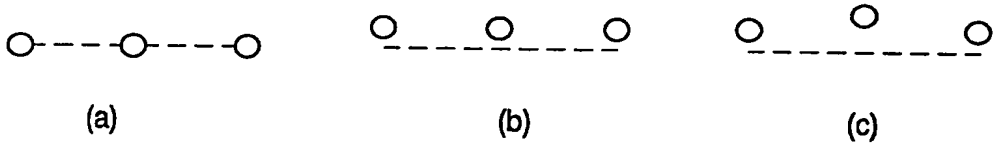

FIG. 3

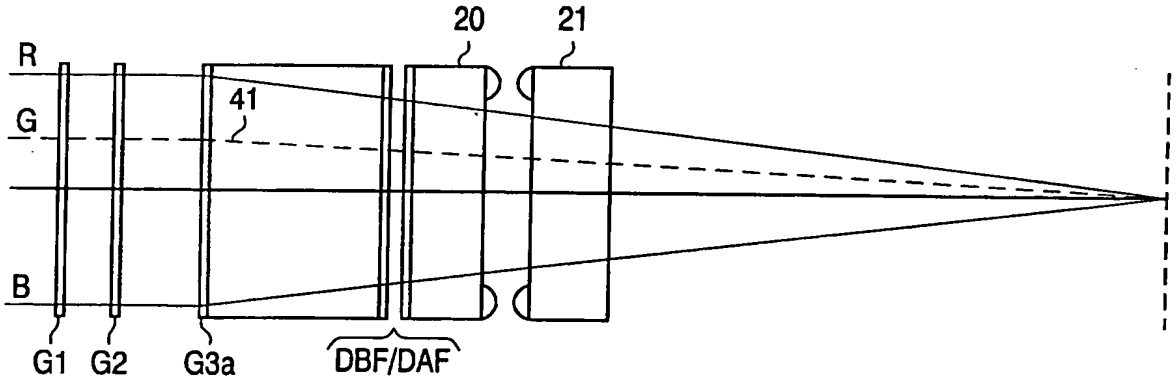

FIG. 4

3/3

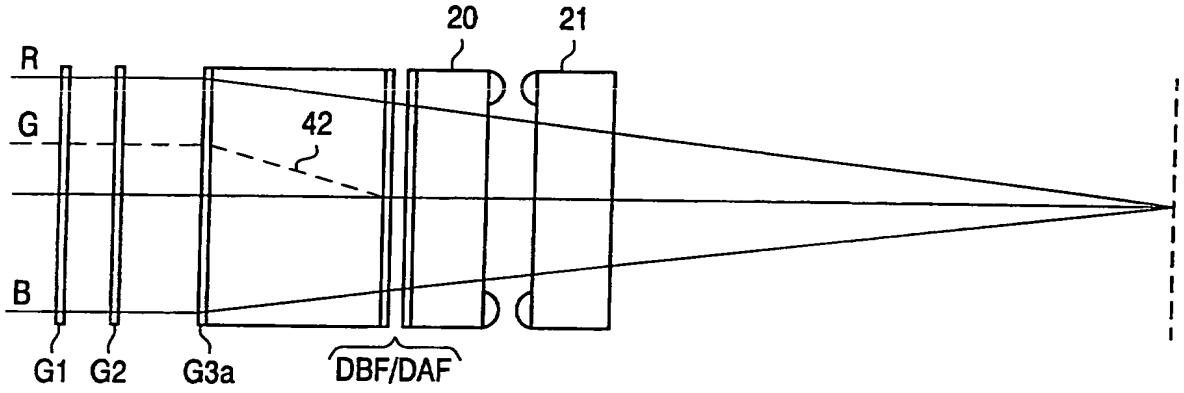

FIG. 5

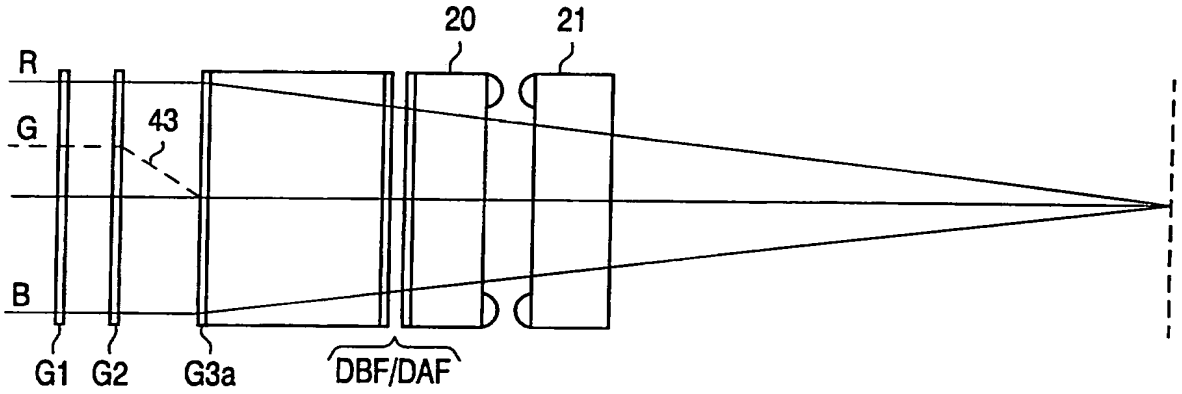

FIG. 6